1 The economic background

The object

Many business decisions involve complicated situations. Because they are complicated, managers often have to concentrate on just a few of the significant factors and hope that they have chosen the most relevant. Sometimes their faith is justified: unfortunately, all too often decisions are taken which closer analysis could have shown to be wrong or inadequate. At the other extreme, some managers try to deal with a complex problem by doing their best to consider a vast number of factors without making any effort at distinguishing the significant from the trivial.

Calculating the balance of advantage when a company is considering whether it would be worthwhile to adopt a system of shiftworking is a complicated matter, and it is important that a firm's accountants have a sound procedure for making the calculations. Equally important, it is essential that everyone involved—and especially those who may well be asked to work on shifts—should know as much as possible about the question so that a company's decision for or against shiftwork is the result of a collective choice and not simply one imposed by management.

Making the decision

A company usually begins to consider shiftwork when there has been an increase in demand which the management reckons is likely to be more or less permanent and which it knows cannot be met from existing capacity. The company therefore has to decide whether to expand its plant or introduce shiftworking.

In dealing with such a situation, the first questions the company asks must concern such practical matters as the availability of new equipment or labour; or the time it would take to put up new buildings or install new machinery. As the answers to these questions become clear, the problem invariably becomes more complicated. New equipment might be obtained reasonably quickly, for example, but only at a price substantially higher than that for comparable machines of older design. Yet the machines of recent design promise impressive savings through higher productivity. Local labour could probably be recruited for shiftwork but the personnel manager is convinced the result would be an effective increase of one third in average hourly earnings of all process workers in the factory—whether they were on shiftwork or not. Would productivity rise with shiftworking? The production staff say yes: the personnel manager may be more sceptical. The works management could be adapted to shiftwork, but the junior staff—who would probably end up with most of the less popular shifts—may be very unenthusiastic. It is not surprising if in a situation like this a company loses sight of what it would achieve by going over to shiftwork.

The greater use of capital

Multiple-shift working is a way of achieving greater use of industrial capital. There are many variants and combinations of shiftwork and overtime. A factory might progress (assuming its sales remain buoyant) from a single-shift eight hour day by adding regular overtime, then go on to a double-shift system; later it might add overtime to the two shifts, and it might consider three, or even four, shift systems. With weekend work as well, the ultimate is the plant which is worked 24 hours a day, 365 days a year. In some industries—such as chemicals, glass or iron and steel—continuous working is a matter of technical necessity: in most other industries, shiftworking is a matter of *economic choice* for both workers and management.

In this booklet we shall refer frequently to systems of high utilisation and low utilisation. These are relative terms. *Low utilisation* will generally be used to describe single-shift working but it could refer to double-shift working when compared with, say, a three-shift system. *High utilisation* may refer to a double-shift system when compared with single-shifts or to a three-shift system when compared with single or double-shift systems. The level of utilisation is best measured, however, by the number of annual operating hours of the plant.

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About a quarter of all operatives in British manufacturing industries are now classified as shiftworkers. A recent survey suggests that between 1954 and 1968 there was a substantial increase in the proportion of British workers who were on shiftwork. But there was a higher level of activity in several important shiftworking industries in 1968 than in 1954, and the real upward trend in the growth of shiftworking in this country in the late 1950s and early 1960s was probably rather modest. In the past five years, however, the upward trend appears to have accelerated.

The fact that we do not make the most of our industrial capital has important consequences for our standard of living. Each year, as a country, we have to devote a proportion of our national output to future growth rather than to consumption. What this proportion is depends not only on our rate of economic growth but also on the average additional output we get from any addition to industrial capital. Shiftwork is an important way of increasing the productivity of capital: the higher our productivity of capital the faster our national growth rate.

If all additional manufacturing investment in the UK were planned for two shifts (and achieved this) our economic growth rate could be increased by as much as one percentage point each year. This could mean a considerable increase in the money that might be spent each year on hospitals, schools or roads; it could mean that we would have more money to spend on luxuries with fewer government restrictions on hire purchase; it would certainly mean that we would as a nation enjoy a higher material standard of living.

Obsolescence and shiftworking

The key to the attractiveness of shiftwork to management lies in the fact that machines decline in value with the passage of time even when they are not being used. This depreciation is caused mainly by changes in design and capacity which make older machines less economic to run than new machines. According to some estimates about two-thirds of the total depreciation of fixed capital of manufacturing companies is due simply to the passage of time or obsolescence. (The remaining one-third is due to use, more commonly known as 'wear and tear'. In theory, wear and tear per unit of output should be the same whether a factory works shifts or not. In fact, many machines wear down more rapidly if they are frequently stopped and started: others benefit from stops for rest or maintenance).

Consequently, the more continuously a machine is used, the lower to the company is the cost of obsolescence for each unit of output. For example, a company might plan to produce £1 million of annual output and finds that with a single-shift system £1.2 million of fixed capital is required. It expects to make gross profits of £300,000, and it reckons that depreciation would account for £170,000, of which £120,000 is due to obsolescence (which is 10 per cent of the £1.2 million value of the equipment) and the other £50,000 to 'wear and tear'. A double-shift system could produce the same output for half the capital—that is, £600,000: but annual obsolescence would become 10 per cent of that £600,000—only £60,000. If there were no increase in labour costs and everything else including wear and tear remained the same, double shifts should mean an increase of £60,000 in net profits.

The effect on labour costs

In fact, such savings in capital costs are usually (though not always) achieved at the price of an increase in labour costs. There is nothing surprising in this. Labour costs tend to rise because shiftworkers need to be compensated for working during other than normal hours. When there is not enough work to go round, most people would prefer having a job on shiftwork to having no job at all. As, however, most people do not find shiftwork as pleasant or convenient as 'normal' work, in countries with full employment it is only fair that those who work on a rotating shift system or whose work is largely done outside normal hours should be paid a premium for agreeing to work unattractive hours.

In many cases, these premia have been incorporated into national wage agreements: it is not unusual for a premium of twenty per cent of the basic wage to be paid to shiftworkers. In fact, the negotiated premium is only one way in which shiftwork can mean higher hourly earnings. For instance, the effect of the provisions of the Factories Act* is that, if the labour force is mainly female, shiftworking usually involves the 'double-day' system of two shifts between 6 am and 10 pm, which is often not so attractive to either side as it appears at first sight. Even if they are not paid a shift premium women on the 'double-day shift' system normally receive at least a half-hour meal break during working hours which is paid for by the employer (as it is not in the case of single shift workers). This effectively increases the average hourly wage by 6¼ per cent (the cost of 2½ hours of 'lost' production per week). An employer could, of course, use an all-male labour force but, as it may be several years yet before women in general receive equal pay, this would also raise his labour costs—in some cases prohibitively. It is fairly common for an employer to continue day shifts for women workers and to hire a permanent night shift of men at higher wages.

The employer may offer shiftworkers higher hourly wages—but this does not necessarily mean that a worker's take-home pay will also be higher. The relation between hourly earnings and number of weekly hours is naturally important, and it can lead to the need for difficult decisions by workers who are being asked to go on to shiftwork. An employer may offer the same weekly wage as before for fewer hours—yet many of these hours will have to be worked at night. The workers have the attraction of more free time; on the other hand, this additional free time will hardly be at convenient hours for themselves or their families.

A more difficult situation for employees might arise if they were offered terms for shiftwork which actually involved a cut in take-home pay. Where a factory had been working long hours of overtime regularly, it would be quite possible that in adopting a multiple-shift system the company would considerably reduce the average hours worked by its employees; although hourly wages would increase, weekly earnings might in fact fall. Taking a long view, or with a different previous history, the majority of workers concerned might prefer the proposed shift system; certainly it does not seem desirable, if only for health reasons, to work, say, ten or more hours of overtime a week on a regular basis. It is difficult, however, for a worker to be expected to adjust to a lower level of earnings, even with shorter hours. Where productivity rises sufficiently it may enable the employer to make up the difference by substantially higher hourly earnings; or the change might be timed to coincide with a general increase in wages (eg, as part of a package deal). There is no simple solution, however, and each case can only be approached on its merits.

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* The general effect of the Factories Act is to preclude shiftwork for women and young persons though it may be authorised for them between 6 am and 10 pm on any week day except Saturday and between 6 am and 2 pm on Saturday. The Secretary of State has power, however, to grant exemptions from the restrictions of the Act by special order, and the DEP say that applications for special exemption orders, enabling an employer to employ women on a night shift, are seldom refused. Some changes in the provisions of the Factories Act were put forward in the report of a working party of the National Joint Advisory Council on *Hours of employment of women and young persons employed in factories*, DEP, 1969. Revisions of the Act as it affects shiftworking are still under consideration.

The employer, on the other hand, invariably has to accept that he will have to pay higher hourly wages if he goes over to shiftwork*. Unless output per man-hour also increases, it follows that his labour costs of production per unit of output are bound to rise. Some people believe that, if anything, it is likely to result in a fall of productivity because of the difficulty of providing adequate supervision at night. The facts are more ambiguous: some studies have suggested that if the incentive system is right, and morale is high, the productivity of workers who in effect are supervising themselves is actually higher. In particular, this seems true of male workers who agree to work permanent night shifts in return for substantial financial rewards. When a shift system is introduced in place of a system that involves many hours of overtime, it is not unusual for productivity to increase sharply—either because of reduced fatigue or because under the old system workers were anxious not to increase output too much in case they would cut their own overtime and therefore their earnings. Indeed, in one engineering plant in the North East the change from two shifts with very heavy overtime to three shifts without overtime led to an increase in productivity of no less than 40 per cent.†.

Calculating the advantage

Whenever shiftwork means that labour costs per unit of output will be higher, a witch to shiftwork will still be attractive to an employer if it is likely that he will make considerably better use of his capital. When considering a possible move to shiftwork, an employer has to set the higher potential profits due to capital saving against the reduction in profits that is likely because of higher labour costs. Two methods of making this calculation can be used:

Rate of return approach

This shows which shift system will give the highest return on capital employed (ie, annual net profits expressed as a percentage of the book value of capital).

Cost of production approach

This means choosing the shift system which, in a certain sense, yields the lowest cost of production per unit of output.

The two methods do not always give the same answer. When they differ, the rate of return approach should be used because it is more generally valid. How the two methods differ, and why the first is preferable when they do differ, can be best illustrated by the examination of a typical case.

Vhere multiple-shift working requires the employment of more workers for a given me of output than a system of single shift plus overtime, the employer's indirect costs national insurance and other social security payments and fringe benefits) will also be eased.

e implications for a firm's calculations of changes in productivity due to shiftworking are ssed in Chapter 4 (See also Appendix A).

2 A typical case

In this chapter, we will be analysing a typical industrial case of a company whose sales have been at a consistently high level for many months: now it has to decide whether to adopt a double-shift system. An examination of this case will reveal the basic facts one should look for and how they should be organised. This in turn will lead us to a theory which can be expressed in a convenient formula and which can be applied, with appropriate modifications in detail, to other cases.

Effect of scale of output

The example is that of a light engineering company in the Midlands which produces a consumer product, and is in fact the company quoted in Chapter 1. This company was looking for an annual sales volume of £1 million which would require plant valued at £1.2 million if produced on single shifts and plant valued at £600,000 if produced on double-shifts. It is essential to note that the sales volume the company was looking for was relatively large: if it were not there would be little point in considering any shift system. Indeed, the expected scale of output is one of the most important factors in a shiftwork decision. Limited sales volume is a definite barrier to a more intensive use of plant because below a certain level industrial equipment cannot be 'subdivided': at this point the minimum feasible size of plant has already been reached or closely approached. In other words, if the market is large enough just to obsorb the entire annual output of a given item of equipment when single-shifts are worked, putting on an extra shift will not produce any capital savings, and so additional shifts would be useless. The larger the expected sales volume, the less significant this problem is likely to be.

In the light engineering case, when single-shifts were worked, the final product was assembled by women. The parts were machined in the same factory and each one went through several processes before reaching the assembly stage. When the management suggested that the female staff consider a 'double-day' system, the women were not at all keen on the idea. As the assembly procedure was not capital-intensive, the proposal was dropped. Instead, the management concentrated on the various machining stages where much of the equipment was automatic and expensive. Here, a two or even three-shift system was quite possible, and informal talks between the management and union officials indicated that, if they were compensated sufficiently for working unattractive hours, the men would agree to shiftwork.

Classification of costs

The first step the management took was to classify its costs. Important savings in *fixed capital* could obviously be made because the company was going to make more intensive use of its expensive machines. Labour costs would be higher. Many other costs, however, were not going to vary significantly either way. As we saw earlier, *depreciation due to 'wear and tear'* is not altered whether a machine is worked continuously or not: similarly, *fuel*, *power* and *raw material costs* would not vary much per unit of output.

Those costs which will not on balance be significantly changed per unit of output b changes in the rate of capital utilisation are classified as *neutral costs*. *Space heati costs*, on the other hand, could well rise in some cases because of nightwork. (I contrast, in continuous process industries such as chemicals, glass or aluminiu smelting which consume a lot of heat, raw material and fuel costs per unit of outp would be distinctly higher in the absence of shiftwork).

It is often thought that a switch to shiftwork will lead to savings in *inventory costs*—the cost of holding stocks of finished goods, work in progress, and materials and fuel in the ordinary process of production. For the most part this is a fallacy. Most inventories, at any stage of the production process, are held to provide insurance against fluctuations in the supply of materials or work in progress or in demand for the finished product. The scale of stocks required to provide a given amount of insurance against fluctuations depends basically on two factors: (a) the sharpness of the fluctuations; and (b) the annual or weekly volume of output.* Neither factor is affected in an obvious way by shiftwork.

As they examined the costs of production, some executives of this Midlands company felt that a move to shiftworking would bring major savings in *working capital* because each partly-finished component would pass through the various stages more quickly. Further investigation showed that while this would be a valid argument in some areas of heavy engineering, it would not normally apply when flow production methods were used, as was the case in their plant.† Here, the proposal was that the components would be machined on a day and night system. About half the parts arriving at the assembly section would have been produced during the day shift of that same day while the other half would come from a stock built up by the night shift during the preceding night. This would take the place of the arrangement on the single-shift system whereby at the start of the day stocks of components waiting between processes were sufficient approximately for an hour's production: *after this they fluctuated hourly*.

Under the new scheme, the assembly department would have at the beginning of each working day a large stock of components waiting for assembly. This would, however, be run down continuously during the day. Working capital needs for one half of the assembly department's activities would increase, but the reserve of parts could be made available to the other half. Consequently there would be no need for any extra insurance against variations in output between the machining and assembly departments. It is difficult to say in this case how working capital requirements would have been affected, but they would probably be higher. In some cases, however, the cost or technical problems of accumulating partly finished work are such that a company must try to put the whole plant onto shifts—even though there is no justification for this on capital-savings grounds. (When this happens, of course, working capital requirements remain more or less unchanged.)

There is no problem if it is possible to arrange for an even balance of partly finished products at each stage so that when stage A on one product has been completed, the men at stage B have just finished their work on another item and are ready to begin work on the new one. But if the men (and their machines) at stage B have been idle part of the time, the quicker that stage A can be completed—by shiftwork—the better. This difficulty usually arises when a company experiences a sudden sharp increase in demand or an unusual bunching of orders and when it cannot find the labour to introduce double-shift work at stage A.

From this, it is evident that working capital costs are not necessarily 'neutral'—that is, unchanged per unit of output whatever the production rate. Each case has to be examined separately. Nevertheless, for the sake of simplicity, in the example of the Midlands company, we are assuming that these costs are in fact neutral.

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* It is well known that the scale of stocks required does not increase in proportion to the volume of output (in fact, according to the laws of probability the general presumption is that required stocks may vary as the square root of annual output volume) but the point remains that for a given annual volume stocks required are not affected in an obvious way by the shift system chosen to produce it.

† These executives would have been right about, say, shipbuilding where a 'one-off' product is made in stages, with each stage having to await the completion of the previous one. Because a ship under construction cannot be moved until it is launched, the fixed capital of the yard and slipway are locked up in successive stages of production. So are the materials and components of previously completed stages. The potential advantages of shiftwork in the UK shipbuilding industry have long been known, but demarcation difficulties (which are now being remedied) created problems when partly finished work had to be transferred from one shift to another.

Getting the facts

After several weeks of discussion, the managing director asked the responsible departments for answers to a series of key questions:

How much use would be made of the machines under the different systems? Assuming that there would be no shiftwork in the assembly department and that an all-male labour force would be used in the machining departments, how many yearly hours of operation could be expected from a typical single-shift system and how many from a rotating day and night two-shift system with no overtime? In the initial discussions it was assumed that there would not be any overtime on the single-shift system either.

Answer The single-shift system with no overtime would mean working eight-hour shifts in a five-day week. Two weeks' production would be lost each year when the plant was closed for holidays, so the machines would be used for 2000 hours each year. A double-shift system would yield 4000 hours of use. In their reply the executives argued, however, that it was not realistic to assume that there would be no overtime on a single-shift system.

What would the average hourly earnings of all shop floor workers be? The answers were to take into account both the piece work rates (or any other bonuses) that were already paid on day work and the likely cost of the extra amount that would have to be paid to employees for working double-shifts.

Answer Average hourly earnings on the present single-shift system were 50p—including holiday pay. However, it was impossible to be exact in forecasting what premium would need to be paid if double-shifts were introduced because that would depend on plant-level negotiations. It was thought unlikely that the final negotiated figure would be less than 20 per cent above the current earnings, and there was the possibility that it might in the end turn out to be 30 per cent. Consequently, the average hourly earnings on double-shifts would be somewhere between 60p and 65p. In view of this, the company decided to make its initial calculations on the assumption *that hourly wages would rise to 62½p, an increase of 25 per cent.*

What would the consequences be for productivity?

Answer Providing a satisfactory answer to this question proved difficult. If the original assumption that there would be no overtime on single-shifts were strictly followed, there was no reason to expect that output per man-hour would differ whatever system was used. On the other hand, if overtime was used both the productivity forecasts and the earnings forecasts would depend upon the actual amount of overtime; it was felt that productivity would be higher the less the amount of overtime per worker. Assuming that no overtime would be necessary if double-shifts were worked, the company decided to make estimates of the cost of three possibilities for single-shift working—first, that no overtime would be worked; secondly, that each operative would do five hours overtime a week on average and that average output per man-hour would not change; thirdly, that he would work an average of five hours overtime each week but output per man-hour would be five per cent lower. (In each case, it was presumed that overtime pay would be time and a third).

What fixed capital, including factory space, was needed in the machine shops, assuming that the annual value of their output was £1 million?

*Answer** The accounts department put the value of capital required for a single-shift system at £1.2 million. They further reckoned that as the required volume of output was large enough this amount of capital would be approximately halved with a double-shift system.

What would 'neutral costs' come to, assuming one included all such costs that were attributable to the product (**except, of course, those in assembly**)**?**

Answer Accounts department estimated that with a one-shift system the overall annual depreciation rate was 14 per cent. However, as we saw in Chapter 1, some of this is due to wear and tear and the rest to a decline in value simply because of the passage of time. Accounts thought that the correct breakdown would be to allocate just under one third of all depreciation—that is, about 4 per cent—to wear and tear while the rest would go on obsolescence. What is more, they felt that the same figure for wear and tear which came to 5p for every £ of output, should apply to double-shifts as to single-shifts. But what about staff salaries and other overheads? These costs included head office expenses, salaries of executives who would not be working shifts, sales costs, etc. Doubts were expressed about the economies that would be found here by working double-shifts. In fact, these costs enter the calculations only in so far as they are increased or decreased per unit of output: there is no reason to suppose that the decision to produce a given output on double as opposed to single-shifts, *as distinct from a decision to expand output*, would affect these overheads. In the event, the Midlands company decided that neutral costs including wear and rear totalled 25p for each £ of output.

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* For a detailed discussion of the correct way to estimate the value of capital see Appendix A.

What rate of obsolescence (depreciation attributable to the passage of time) should be applied to the machines?

Answer This figure follows from the calculations made for the previous question, when wear and tear had been settled. As overall depreciation was reckoned to be 14 per cent, while wear and tear was put at 4 per cent, the remaining 10 per cent was attributable to obsolescence. This worked out at £120,000 for single shifts and £60,000 for double-shifts (10 per cent of the necessary fixed capital).

When the answers to all these questions had come in, the results were tabulated so that a direct comparison could be made of the costs involved in four possible systems of operation—single shifts with no overtime; single shifts with five hours overtime per week with no loss of productivity; single shifts with overtime and five per cent lower productivity; and double shifts, with no overtime. These results are given in Table 1.

Notes to Table 1

All systems assume a basic 8-hour shift, 5-day week, with two weeks annual holiday. For simplicity the calculations exclude holiday pay, SET etc.

1. Wear and tear has been set at 5 per cent and other neutral costs at 20 per cent, making a total of 25 per cent of the worth of the output.

2. This takes into account the possibility (system C) of a 5 per cent fall in output per man-hour, which would have to be made up by workers doing a greater number of hours of work in total.

3. Two of the systems being examined (systems A and D) did not involve any overtime while the other two included an average of five hours of overtime for each worker per week.

4. For systems B and C, which did involve overtime, the figures include the effect of five hours overtime at time and a third each week. For system D, the double-shift system, the company had decided to assume that a premium of 25 per cent would have to be paid to workers for agreeing to double shifts.

5. These are the annual earnings (average hourly earnings × annual hours per head) averaged over 50 weeks.

6. This figure is based on the average hourly earnings and the total of man-hours required.

7. As explained, the company reckoned the value of capital required, for a single-shift system was £1.2 million and for double-shifts £600,000. However, overtime working accounts for the differences for systems B and C. For system B (when overtime was not accompanied by lower productivity) the capital needed is reduced because overtime working represents an increase in utilisation; fewer machines are needed to produce the given output. For system C, however, which involved overtime but a fall in productivity, the capital needed is higher because the machines are running less effectively and because the use of buildings (whose rate of depreciation is largely unaffected by the rate of output) is also less effective and this is equivalent to a reduction in utilisation compared with system B.

8. Profits net of wear and tear are annual output less the total of neutral costs and the wage bill. For system A, this is £1 million less £250,000 (neutral costs) and £500,000 (wage bill) = £250,000.

9. In each case this is 10 per cent of fixed capital.

Table 1
Forecast results for
different shift systems

	System A (One shift, no overtime)	**System B** (One shift; 5 hours overtime; no loss of productivity)	**System C** (One shift; 5 hours overtime; 5% lower productivity)	**System D** (Two shifts; no overtime)
Utilisation level				
Annual plant operating hours	2000	2250	2250	4000
Output				
Annual forecast output (£000)	1000	1000	1000	1000
Neutral costs[1]				
Wear and tear (pa) (£000)	50	50	50	50
Others (pa) (£000)	200	200	200	200
Total (£000)	250	250	250	250
Labour				
Output per man-hour	1.00	1·00	0·95	1·00
Annual man-hours required (000)[2]	1000	1000	1052	1000
Employees required	500	445	467	500
Annual hours per head[3]	2000	2250	2250	2000
Average hourly earnings (new pence)[4]	50	52	52	62½
Average weekly earnings (£p)[5]	20.00	23.40	23.40	25.00
Annual wage bill (£000)[6]	500	520	547	625
Capital and profits				
Fixed capital (£000)[7]	1200	1067	1123	600
Profits net of wear and tear (£000)[8]	250	234	205	125
Obsolescence depreciation (£000)[9]	120	107	112	60
Net profits after depreciation (£000)	130	127	93	65
Rate of return on fixed capital	11%	12%	8%	11%

For notes to Table 1 see opposite

Now that the relevant figures have been tabulated as in Table 1 it is possible to examine the two main methods of estimating which of the various options is the best one to pursue.

Rate of return approach

This method tells the company which of the possibilities offers the most attractive return on fixed capital. The essential figures (which come from Table 1) are given in Table 2.

Table 2
Rates of return compared

	System A (One shift, no overtime)	**System B** (One shift; 5 hours overtime; no loss of productivity)	**System C** (One shift; 5 hours overtime; 5% lower productivity)	**System D** (Two shifts; no overtime)
Fixed capital (£000)	1200	1067	1123	600
Net profits (profits less wear and tear and obsolescence) (£000)	130	126	90	65
Net profits as a percentage of fixed capital	11%	12%	8%	11%

The results are not all that surprising and confirmed the original suspicion of the accounts department that, if no overtime was worked and productivity remained the same, it did not make any difference whether single or double-shifts were worked. Profits would be halved with double-shifts but so would the amount of capital required, and both systems would yield a return of 11 per cent.

A higher return might be achieved by keeping to single-shifts and working overtime. From the beginning, however, the management had felt that it was unrealistic to expect that the rate of output per man-hour would not drop if there was regular overtime. Consequently it was all too likely that if a realistic adjustment was made for lower productivity when overtime was worked the outcome would be close to system C. This represented a distinctly unattractive option. Thus for management the effective choice was between system A and system D.

What about the employees in the machine shops? Which system has the most to offer them? Again, using the figures in Table 1, it is possible to make meaningful comparisons (see Table 3).

Table 3
The results for employees

	System A (One shift, no overtime)	**System B** (One shift; 5 hours overtime; no loss of productivity)	**System C** (One shift; 5 hours overtime; 5% lower productivity)	**System D** (Two shifts; no overtime)
Average weekly earnings (£)	20.00	23.40	23.40	25.00
Average weekly hours	40	45	45	40
Average hourly earnings (new pence)	50	52	52	62½

By going on to a double-shift system, the employees would earn an extra £5 per week without doing any overtime. None of the combinations of single-shift-and-overtime is in any way as attractive—they involve distinctly more hours work for less rewarding returns. But the financial advantage of working double-shifts would still be gained at a price—for some at least of the labour force would have to work at less convenient hours.

In this case system D (double-shift working with no overtime) seemed so attractive to all concerned that it was the one that was chosen. The improvement in earnings and the reduction in hours for employees were so considerable that the loss of some free time at convenient hours was not too great a sacrifice. To management, this system gave an opportunity of producing the required output with a satisfactory rate of return on capital.

Looking at the situation in a wider perspective, so far as the efficient use of our national resources is concerned, the necessary output should be produced with half the use of capital resources that at one stage had seemed probable. Regrettably, a solution which is so acceptable all round is not as common as one would like. System C—with productivity flagging on a single-shift system with regular overtime—seems much too common.* It is unattractive to management but it offers relatively attractive wages, and yet in turn makes any transfer to double-shifts unappealing. On the other hand, as a further alternative on system C, one might make up the lost output not by taking on extra staff but by working yet more overtime. In such a case, the rate of return for management would fall even lower than 8 per cent while weekly wages would almost certainly rise above £25. This situation would make *double-shift* working distinctly more attractive to the management but it would reduce the attraction of double shift working to the employees who would then have to decide if they preferred the inconvenience of shift hours (with no advantage in total pay) over the longer hours of a day shift plus overtime.

Cost of production approach

This approach asks the simple question, 'Which system of production will offer the lowest costs of production for each unit produced?' In this context, one includes among 'costs of production' labour and the items of neutral costs which we examined earlier; in addition one has to take into account 'capital costs'—the estimated costs *per unit of output* of the capital employed, and include, as well as wear and tear, obsolescence depreciation and 'interest'. By referring back to the figures in Table 1, one can compare the costs of production in system A (single-shifts) and system D (double-shifts) by relating the relevant figures to a single unit of production instead of using the annual total that is quoted there. Wear and tear, for instance, which is put at £50,000 per £1 million worth of production comes out as 5p per unit of output; obsolescence, at £120,000 for system A, is the equivalent of 12p per unit of output. The resulting comparison is shown in Table 4.

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* It may be argued that this arrangement permits firms to make a flexible response to fluctuations in demand and that a multiple-shift system reduces the operating flexibility which a firm needs to enable it to meet fluctuations in output due to various causes. In so far as the shiftwork system is at a disadvantage in enabling firms to meet fluctuations in demand compared with a system using overtime, this is an example of how 'customary' overtime affects the shift work calculation. The question of the effects of shiftworking on operating flexibility is discussed in Appendix B.

Table 4
Costs of production compared

	System A (One shift; no overtime	**System D** (Two shifts; no overtime
	Costs per unit of output (new pence)	
Wear and tear	5	5
Other neutral costs	20	20
Obsolescence*	12	6
Interest on capital at 7%*	8.3	4.1
Labour costs	50	62.5
	95.3	97.6

According to the 'cost of production' method, shiftwork will not be attractive to management in this case, while the 'rate of return' method indicated that there was no difference between the effects of single-shifts and those of double-shifts. The cost of production method suggests that double-shifts will mean the loss of £23,000 in annual profits compared with single-shifts (as the company would lose 2.3p per each £ unit or just under 2½ per cent of the value of all output†.)

Which method is right?

The two methods give different answers because, basically, the interest rate used in the comparison was set too low. When we examined the rate of return approach, we saw that the company was able to earn 11 per cent on its capital. On the other hand, we used an interest rate of only 7 per cent when making calculations of the cost of production. The lower interest rate puts a lower 'price' on capital and consequently means that less emphasis is given to production methods that will save capital. If the interest rate for the cost of production method is raised to 11 per cent, the costs of production become the same for both methods—and so the two approaches would lead to the same recommendation. As a general rule, whenever the rate of return that a company can earn on its capital exceeds the interest rate in the calculations so the cost of production method will be less favourable to shiftwork than the rate of return method.

A crucial factor in establishing which method is right, therefore, is how accurately one can assess the cost of capital to a company. At first it might seem that current interest rates should give a fairly accurate indication: in fact, a company has to look for a rate of return above the going interest rate. There are several reasons why this is so. In the first place, the interest rate is not as high as the rate a company would have to pay in interest for large amounts of additional capital if it wanted to expand rapidly. Secondly, long term interest rates can be seen as the price of a relatively secure loan (on the lines of a bank loan with the borrower providing security) which does not take commercial risk into account. Consequently, and this is particularly true of a company planning rapid expansion, only rarely can a company finance more than a part of its investment by fixed-interest loans.

If a company was in fact able to borrow large sums of money at a rate of interst well below the rate it expected to earn on the new investment it should rapidly push ahead with expansion plans because this should lead to a bigger increase in profits than in interest charges. Our concern, however, is not with the decision to expand but to find the most efficient way of producing a targeted output. If there is one system—say multiple-shift work—which yields higher profits relative to capital than the present system—say, single-shifts—it always pays to use the more efficient system. The resources which are thereby released can then be used for other purposes—for instance, lower prices or boosting the company's marketing efforts.

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* Both obsolescence and interest are halved when double-shifts are considered. As was found when the company was classifying its costs, a move to double-shifts would mean that capital requirements would be halved.

† In fact, annual profits after depreciation *and* interest would be halved.

The cost of production method, therefore, will give the right answer only if the assumed 'cost of capital' (that is, the interest rate) is the same as the general rate of return within the company before any decision is taken to use shiftworking. Seen another way, it has to be the same as the return expected from a new project if examined with an assumption that only single-shifts will be worked.

An example

This rule may go against the current working practices of some companies. As it is so crucial, discussion of an example should make the lesson clear. Let us suppose that two companies in exactly comparable circumstances are considering going over to shiftwork. Both intend to finance the project from internal funds and to provide for further expansion by ploughing back half the profits. The first company, using the rate of return method, reckons that double-shift working will yield 15 per cent on capital employed against 12 per cent for single-shifts. The second company, using the cost of production approach, with an interest rate of 7 per cent, finds single-shift working more attractive (although it yields a lower rate of return). The first company adopts shiftwork: the second does not. As the market grows, both companies make extra investments up to the limit of their available financial resources, which are equal to half the profits of the previous year. If half the profits are ploughed back, the percentage increase in assets must be half the percentage of profits to assets—in other words, the rate of return. As the company using the cost of production approach has a lower rate of return it will have a lower rate of growth and should see its market share decline; on these assumptions, it must have made the wrong decision.

In defence of the cost of production approach it will probably be argued that this comparison is unfair. It will be maintained that the second company will continue to finance expansion by loans at the assumed 7 per cent. In addition it will be able to charge lower prices and hope to build up its market share through competitive pricing. The argument would be irrefutable if it really were possible to continue to finance rapid expansion in this way. In practice this is hardly possible, as the company's ratio of debts to assets would steadily rise in a way that would cause increasing risk, and concern, to management and creditors. It is likely that the company would have to pay a higher interest rate until (probably) the gap between the interest rate and the rate of return had been closed. As most additonal finance must come either from profits or from issues of new shares, it is right to conclude that the rate of return method is the only logical method of appraising such schemes. It is clear that the internal rate of return is the correct way of measuring the 'cost' of new capital within a company.

As a result, one must conclude that the Cost of Production approach should be used only if the interest rate or 'cost of capital' which is built into the calculations is the same as the general internal rate of return within the company. The rest of this booklet assumes, therefore, that the rate of return approach is being used.*

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* In some discussions of the approach put forward in this booklet it has been suggested that Discounted Cash Flow (DCF) concepts should have been used in place of the rate of return approach. This point is dealt with in Appendix C where the two approaches are compared and it is argued that in many cases the DCF approach will give the same answers as the rate of return approach.

3 Theory and practice

The critical factors
When we were examining* a typical illustration of the rate of return approach, we found that for the management of the Midlands light engineering company neither single nor double-shift working had any advantage over the other. In fact, the figures in that illustrative case were deliberately adjusted so that they would present a 'critical' situation—one where the rate of return was the same whether a single or double-shift system were used. Consequently, it should now be possible to identify the factors which tend to tip the balance for or against shiftwork.

Clearly, one key factor is the amount by which hourly wages are higher on double-shifts compared with single-shifts. For the purpose of their initial calculations, the management reckoned that hourly wages would rise from 50p to 62½p if double-shifts were introduced. However, if the employees agreed to work double-shifts, not for 62½p an hour but for 60p an hour, the annual wage bill for System D in Table 1 would be cut from £625,000 to £600,000, net profits increased to £80,000 and the rate of return increased to 13⅓ per cent.

On the other hand, suppose the management had slightly underestimated how much extra the company would have to pay workers on double-shifts and that the average hourly wage became 65p instead of their estimate of 62½p. The result would be that the rate of return would drop to 8⅓ per cent.

The utilisation differential
The difference in hourly wages between single-shifts and double-shifts is specifically linked to the greater utilisation of machinery and is called here the *utilisation differential*. It can be defined as the percentage increase in hourly labour costs that an employer has to pay per unit of output to get greater use of his machines. As it is assessed for each unit of output, the utilisation differential can take account of any variations in productivity that may result from a change to shiftwork.

It is possible that in going over to double-shifts a company will have its employees working for fewer hours than on the single-shift system. In our example we have assumed that if double-shifts were worked (system D) employees would still work a basic 40 hours. But what if working hours were in fact cut to 35 hours? Although hourly wages remained the same (that is, 25 per cent above the basic rate), the increase in use of the machinery would not be the same as with a 40-hour week. The capital required for double-shifts would be increased and the return on capital reduced, probably tipping the balance in favour of single-shifts. If the shorter working week was not matched by lower weekly earnings (ie if hourly earnings were increased), this would further increase the utilisation differential and the bias against shiftwork.

Not surprisingly, differences in productivity between one system and another can be crucial. The higher the output per man hour worked, the more efficiently the machines are being used—which amounts to the same thing as longer hours of use. We saw that the Midlands company thought that if single-shifts-plus-overtime were worked output per man hour would drop by 5 per cent. By going over to double-shifts, it would gain in two ways—first by using the machines more and secondly by higher productivity. By referring to Table 1, one can see that the capital saving between system C (single-shifts with poor productivity) and system D (double shifts) is considerable.*

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* See page 10.

* As was seen earlier, all estimates of capital-savings depend on the scale of output being sufficient (see page 5).

The capital-saving

The *capital-saving* can be defined as the percentage *reduction* in capital required that results from greater utilisation of equipment. If there is no difference in productivity between one system and another, the capital-saving is the extra hours of use expressed as a percentage of the total number of hours use on the *higher* utilisation system. Had the Midlands company moved from a single-shift system with five hours overtime (system B) to double-shifts with no overtime (system D), the numbers of hours worked in a year would have risen from 2250 to 4000. The actual increase of 1750 hours is 43.7 per cent of 4000. From Table 1 one can work out that the reduction in capital required—from £1,065,000 for system B to £600,000 for system D—is 43.7 per cent.

By increasing the wage bill the higher hourly wages that are paid for shiftwork reduce profits and reduce the return on capital. By contrast, the savings in capital that result from shiftworking press in the opposite direction. However, besides the utilisation differential and the capital-saving, there is a third important factor which is often ignored. Shiftwork increases labour costs so that capital costs can be saved: by changing the basic wage rate one is bound to change the relative importance of wages and profits.

The basic ratio

It follows, therefore, that the greater the importance of labour costs in overall costs the less likely it is that increasing them still further through shiftwork will be worthwhile to the employer. Putting the point the other way round—the higher the ratio of profits net of wear and tear to wages the better the prospects of a change to shiftwork. We call this ratio the '*basic ratio*'. (For example, if the basic wage rate had been 52½p instead of 50p and everything else in the calculations had been the same, the annual wage bill would have been 5 per cent higher on all the systems under consideration. The return on capital would have been lower on all systems but would be *reduced less* for single-shifts than for double-shifts).

If we use the criterion of maximum return on capital employed, multiple-shift working is likely to be more attractive to management than single-shift working if:—

(i) the resulting increase in labour costs (taking account of the effect on hourly earnings and productivity) is not too high.

(ii) the reduction in capital needed per unit of output is substantial (after taking into account the changes in the hours machines are worked and any productivity changes).

(iii) the ratio on single-shifts of profits (net of wear and tear) to wages is high.

A simple formula

By using the example of the Midlands company it should now be possible to see how these various factors can be brought together in a simple formula. In that case a move from single to double-shifts would mean the following:—

(1) Utilisation differential (hourly wages up from 50p to 62½p)	25 per cent
(2) Capital-saving (From £1.2 million to £600,000)	50 per cent
(3) Basic ratio on single shifts (Profits net of wear and tear of £250,000 against wage bill of £500,000)	50 per cent

As we said earlier, this was a 'critical' case, for both single and double-shift working would give a return of 11 per cent. At first sight this is surprising for the gain in capital-saving would be *twice* the percentage by which hourly wages would rise. However, this result is not a coincidence when, as in this case, profits net of wear and tear are only half the wage bill.

In other words, there is a close connection between all three factors which is crucial to any appraisal of shiftworking, and which can be expresssed as follows:—
If the ratio of utilisation differential to capital-saving is less than the basic ratio of profits (net of wear and tear) to wages, shiftworking will be more profitable. If it is higher, single-shifts or the lower utilisation system will be more economic.

The cost of utilisation

Put another way, the ratio of the higher wages that are necessary for shiftwork to the savings gained in capital, can be seen as the *price* one has to pay in extra labour costs for each unit of capital-saving. This can best be illustrated by imagining that our company had also considered a system of treble-shifts: this would have meant 6000 operating hours and a capital-saving (assuming there was no change in productivity) over the single-shift system A of 66.6 per cent (assuming for the sake of argument that limited sales volume presented no obstacles). But hourly wages would also have been higher than the basic 50p, and if for the sake of argument we take it that they rose by 33.3 per cent to 67p, the ratio of utilisation differential to capital-saving would still be 1 : 2 and so, according to the formula the same rate of return would be achieved with treble-shifts as with double or single-shifts. Although the level of machinery utilisation is much higher, the basic elements of the situation have not changed. These basic elements are expressed in the *price* of a unit of capital saved in terms of the higher wages paid. We can call this the cost of utilisation: it is defined precisely as the utilisation differential divided by the capital-saving.

The formula simplified

Now the formula can be simplified:
*Increased utilisation is economic if the cost of utilisation is lower than the basic ratio and vice versa**

National implications of the formula

The same formula can be applied to the national economy. The 'national basic ratio' is the ratio of the product of *national average capital per head* and the *national average rate of return on capital employed* to *national annual wages per head.* If the economy were growing at a steady pace, with a steady growth of output per man due to greater efficiency and more capital per man, it is quite likely that the rates of growth of capital and of output per man would be about the same. If wages were increasing as fast (or prices falling as fast) as output per man, profits per man would also be growing at this rate. So the average return on capital employed would tend not to change. Consequently, there would be no tendency for the incentive to work multiple shifts to change in either direction, as all the economic forces would be constant or self cancelling.

Of course, the national economy does not in practice grow so steadily, but the example provides a useful indication of the way things are likely to go in various circumstances. In the absence of a deliberate policy, we cannot expect a major upward trend in shiftwork unless there is a tendency for:

(a) the purchasing power of hourly earnings to rise less rapidly than output per man-hour;
(b) capital per man to rise faster than output per man-hour;
(c) average cost of utilisation to fall.

In the UK, if anything, real hourly earnings have been rising faster than output per man-hour but this may have been largely offset by capital per man tending to rise faster as well. The upward trend in shiftwork is probably due mainly to declining cost of utilisation, which in turn is due to a weakening of the adverse effect from limited output volume as markets expand, industries are rationalised and products standardised.

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* That is, if $\frac{\%\text{ increase in hourly wages}}{\%\text{ reduction in capital needed}}$ is *less* than $\frac{\text{profits net of wear and tear}}{\text{annual wage bill}}$

4 Some adjustments to the formula

It is now necessary to see how this simple formula has to be adjusted to deal with a considerable variety of different circumstances. In particular, it can be adjusted to take account of (i) differences, resulting from a move from single to multiple shifts, in productivity due to human factors or to limited sales volume; (ii) 'neutral' costs which are not neutral; and (iii) the need to consider the various processes in a factory separately.

Productivity difference due to human factors

In all calculations that were discussed in Chapter 2, it was assumed that if double-shifts were introduced then there would be no falling off in productivity. But what if the company expects that productivity will be affected—upwards or downwards—by a change to multiple-shifts? We can allow for such changes in output per man-hour quite simply. If productivity falls under shiftworking, the cost of labour is increased and the equipment is less efficiently used. So the utilisation differential is increased and the capital-saving reduced.

These changes can be accounted for through a '*productivity adjustment*' which is the percentage increase in productivity on the single-shift system that one expects to achieve through working multiple-shifts. When productivity is expected to fall, the adjustment is negative (with a minus sign in front). To obtain the correct figure for the cost of utilisation, *subtract* the adjustment from the top line of the formula and *add* it to the bottom line. This has the effect of lowering the cost of utilisation and raising the capital-saving. If the adjustment is negative because productivity is expected to fall on the higher utilisation system, the cost of utilisation is raised. For instance if system D was thought to involve a five per cent fall in output per man-hour the calculation would be done as follows:

(1) $$\text{Cost of utilisation} = \frac{\text{utilisation differential}}{\text{capital-saving}} = \frac{25}{50} = .50$$

(2) Cost of utilisation after

$$\text{productivity adjustment} = \frac{25 - (-5)}{50 + (-5)} = \frac{30}{45} = .66$$

Thus the double-shift system D would no longer be economic compared with the single-shift system A.

Productivity differences because of inadequate sales volume

This is important because limited sales volume has been a key cause of the low level of capital utilisation in the UK. Take for example the workings of a brickworks, where clay is excavated from a pit and after several processes is fired in a kiln. The kilns, which need little labour, are operated continuously but the other processes can be worked by single of multiple-shifts, although for technical reasons all the preparatory processes must more or less work the same system. Suppose the company has a modern excavator which can produce on single-shifts all the clay that is needed in a year: if a two-shift system were adopted the excavator operators would find that they were providing twice as much clay as was needed for subsequent processes. Suppose also that the equipment in other processes is more easily divisible and could be used on double-shifts. A two-shift system could halve the capital required in the pre-firing processes but leave unchanged the capital needed in the clay pit. In these circumstances the excavator operators would have to reduce their output and the effect would be similar to a productivity adjustment. It would therefore be necessary to adjust both the capital-saving and the utilisation differential in a way similar to that already described for a productivity adjustment due to the human factor.

In fact, the two adjustments may well interact: if, for example, the rate of output of the excavator operator is determined by factors outside his control, it is not likely that any other productivity adjustment will be needed. But no two cases will be quite the same. (Nevertheless, when setting out the calculations, it is useful to present the adjustments due to limited sales volume as specifically as possible so as to have a clear idea of how matters might be affected if a more optimistic sales forecast were possible).

Non neutral costs

We saw earlier that many supposedly neutral costs (that is, all costs other than capital costs and the cost of labour affected by shiftwork)may not really be neutral—in the sense of being the same per unit of output whether shifts are worked or not. It is difficult to be sure about many of them, and it is best to treat them as a broad group and to reckon that variations either way will cancel each other out. A *cost adjustment* is necessary only if it appears that the overall result for the group as a whole shows a significant bias in one direction—as it does invariably in continuous process industries such as glass or chemicals.

A cost adjustment would take account of the percentage increase or decrease in total unit costs, per unit of output, in making greater use of machinery. It would then be necessary to make alterations to the utilisation differential, in a way which sounds complicated but which is reasonably straightforward. The unadjusted differential is multiplied by the annual wage bill on the single-shift system; the annual total of neutral costs is multiplied by the cost adjustment figure; the two totals are added together and the result divided by the total of the annual wage bill and neutral costs on single-shifts. (One would also have to adjust the basic ratio by adding total neutral costs to total wages on the original low utilisation system.)

Allowance for separate processes

This is the most useful, and the most interesting, modification of all. A factory is not a single process: it is naturally desirable that each separate process which can operate independently of other processes* should do so as efficiently as possible, ie by the best system of utilisation. It is therefore necessary to know whether greater use of a particular machine or section will raise the overall rate of return of the company. Consequently, each process should be examined in turn: as a result, it should be possible to find the best system for the plant as a whole.

A modification of the formula given on page 16 provides the answer (the modification is simple in principle though there are some problems of estimation which are discussed below). The cost of utilisation (the comparison of saving in capital and the price that has to be paid for it) appropriate to the particular process should be calculated in the way that has already been outlined. The ratio of profits net of wear and tear to wages on single-shifts should also be worked out—with one crucial modification. Profits should be seen as 'profits attributable to the process', and wages as the annual wage bill involved *in the process*. It should be straightforward to work out the wage bill but how can one estimate the profits attributable to the process? The answer is by multiplying the capital attributable to the process by the general rate of return of the plant as a whole, net of wear and tear. It is both unnecessary and wrong to try to estimate a particular rate of return for each individual process. However, this modification has one disadvantage: it is not always easy to work out how much of the capital of a plant should be attributed to a particular process. On the other hand, it has the apparent advantage that once the general rate of return has been agreed the same figure can be used for all processes.

Unfortunately, this may not always work. Suppose the formula is applied to a process which is highly capital-intensive and which proves to be most suitable for shiftwork. In these circumstances, before considering the next process, it would be strictly necessary to assume that this process was actually operating shifts. As a result, by using a more profitable system in the first process we have naturally increased the profitability of the plant as a whole. This higher figure is in fact the figure that should be used as the rate of return in the next step in the general evaluation. This means that one cannot consider the processes in any arbitrary order: instead it is necessary to consider them in their order of capital intensity. Of course, if the processes where shiftwork is likely to be particularly attractive account for only a small part of the capital of the plant (or if the plant itself forms only a small part of a larger complex) the problem can be ignored. In that case, it is quite in order to use a single general measure of the rate of return.

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* That is, wherever material in process can be stored.

Another way of doing the same calculation of the basic ratio, if the figures are conveniently to hand, is to work out, assuming single-shifts, the ratio of capital per worker to annual earnings per worker and apply this ratio to the general rate of return. The economic significance of this approach lies in the fact that the ratio of capital per worker to earnings per worker is a measure of the *relative capital intensity* of the process. It reminds us that capital per worker is only one side of our problem: apart from the general 'price of capital' as expressed in the rate of return, wages per worker are just as significant.

Applying the adjustments

It is now possible to see how all the various adjustments we have examined can be brought together. It may seem complicated but all it does is present in a systematic way calculations that should be done anyway. How to get the figures to put into the formula is described in Appendix A. Here the basic steps are spelt out:

Divide the factory into processes which can be worked on different shift systems; make a working forecast of annual sales volume.

Make the following calculations (assuming single-shift working in all processes):

- (i) Capital per head, in each process
- (ii) Annual wages per head, in each process
- (iii) Overall rate of return on capital, net of wear and tear.

Make the following calculations of the effects of shiftwork in *each* process:

- (i) Percentage increase in hourly earnings (all workers)
- (ii) Increase in annual operating hours as a percentage of total operating hours with shift working
- (iii) Combined productivity adjustment due to human factor and/or inadequate sales volume
- (iv) 'Neutral costs' adjustment if needed.

Calculate the cost of utilisation (the 'price' of each unit of capital saved) as follows:

$$\frac{\text{\% increase in hourly earnings after productivity and cost adjustments}}{\text{increase in annual operating hours as percentage of total operating hours with shift working, after productivity adjustment}}$$

Calculate the basic ratio in *each* process as follows:

$$\frac{\text{Capital per head} \times \text{rate of return net of wear and tear}}{\text{Annual wages per head}}$$

Arrange the processes in descending order according to their capital per head.

Compare the cost of utilisation with the basic ratio for the process at the top of the list. If the former is less than the latter, this process should be planned for shifts.

Work out again the overall factory rate of return, this time with the assumption that the first process is on shifts.

Repeat the comparison of cost of utilisation and basic ratio for the second process using the *new* value of the rate of return.

These two steps should be repeated until a process is reached where the cost of utilisation *exceeds* the basic ratio. Neither this process nor any succeeding process should be considered for multiple-shifts.

5 Conclusions

Conclusions for employees

Management is interested in shiftwork because it may increase profits relative to capital employed. Because of this employers can offer higher *hourly* earnings. They will also usually have less need for overtime so that employees on average work less hours. Employers can pay higher hourly earnings, despite the loss of overtime pay, because on a shift system the premium can be paid for all hours worked, not just the ones at the end of the day. Employees may find, however, that although they would be paid the same or more for fewer hours their total wage packets may not rise and where overtime has been substantial may actually fall. Obviously, this is a disadvantage for them but a question they have to ask themselves is whether it is healthy to go on working long hours of overtime year in and year out. If they can participate in a general increase in productivity because of going over to shiftwork with less overtime, it is much more likely that their employers will be able to offer a higher weekly wage packet as well as shorter hours, if they can agree to the shift system.

Conclusions for management

The economics of multiple-shift work are not always simple and it is well worth setting out the calculations in a systematic way. There is a fairly simple formula for doing this, and it shows that shiftwork in a *particular process* is more likely to increase the rate of return on capital employed in *the whole plant* if:

Capital per man (on single-shifts) is high *relatively* to annual wages per man;
The rate of return in the plant as a whole is high;
The expected increase in annual operating hours of the plant in the process, with multiple-shifts, is high *relatively* to the required increase in hourly earnings;
Productivity is favourably affected, or at least not unfavourably affected, due to the human factor;
Forecast sales volume is adequate to avoid 'indivisible' equipment having to be run slowly if multiple-shifts are worked.

The shiftwork decision should not be taken by the cost of production method unless the cost of capital (interest rate) is assumed the same as the internal rate of return.

Conclusions for the nation

There is an important two-way link between economic growth and shiftwork. A faster growing economy is likely to have a higher average rate of return, and therefore is more likely to favour shiftwork. At the same time, an economy where shiftwork is favoured is more likely to grow fast. In the UK a substantial contribution to economic growth could be made by productivity agreements consisting of the following basic package:

Shorter hours (less overtime) with higher hourly earnings.
Shiftwork with higher output per man-hour.

This package would make shiftwork more profitable for management, and more attractive to workers, while at the same time contributing directly to the national objective of accelerating the growth of output per man-hour. Shorter hours reduce fatigue and higher hourly earnings reduce the pressure for overtime earnings, both encouraging higher individual productivity during normal hours.

At the same time, the more that we do to get longer runs of output for individual products in individual plants, the more we reduce the tendency to sub-divide markets into an excessive variety of products, the more likely it is that shiftwork will prove attractive to both sides in industry, and this will in turn contribute significantly to the growth of our standard of living.

Appendix A Getting the figures

The calculations required

One particular advantage of the formula which was outlined in Chapter 4 is that it gives clear instructions on the calculations that are necessary. As a result, it should be possible to avoid other calculations which are unnecessary and confusing. In practice, the actual calculations will depend on the form and detail of a company's internal accounts: with the exception of the productivity adjustment and a breakdown of capital process-by-process, none should cause any difficulty to accounting staff. For the most part, it is a matter of using the best estimates available for the various parts of the formula. The notes below, however, are intended to give general guidance.

Cost of utilisation

This is defined as the utilisation differential divided by the capital-saving (see below for how these are calculated).

Utilisation differential

The *utilisation differential* is the percentage increase in hourly earnings per operative averaged over *all* the operatives concerned (including those on day work only) which will result from the change to a higher utilisation system. It must take account of change in the sex balance of the work force caused by the change to shiftwork, changes in overtime earnings, bonuses etc. In theory there should be little difficulty in making this calculation: in practice it can be very difficult.

The shift premia established in national wage agreements are often unrealistically low (in some cases they are non existent), and the figure may involve some rather uncertain plant-level negotiations. As a general rule—apart from those industries where shiftworking is built into the pattern of work, such as chemicals—it seems that the average shiftworker, who is more likely to be a male worker, receives between 20–30 per cent more than the average non shiftworker. The problem is that in many cases managements are not willing to start bargaining until a decision in favour of shiftwork has been taken in principle because of the disturbance the initial announcement may cause. Difficult though it may be, it is important for management to try to reach a figure which is the fair bargaining price to obtain the number of shiftworkers needed rather than to confuse the issue by asking 'what is the highest premium I can afford to pay?'

It is more difficult to estimate the possible productivity adjustment. There are many conflicting opinions about the effect of reduced supervision, for example. There is no doubt that some workers, if left alone at night and given suitable incentives, display higher productivity than in daytime conditions. This may be because men who volunteer to do permanent night work may be those who want high earnings. Moreover, it has been known for a three-shift system to reduce the strain on the supervisors considerably compared with a two-shift system with the consequence that total productivity increased. On the other hand, despite the greater informality and higher morale of night work, it often happens that workers tend not to do too much, in case their output shows up embarrassingly well against the day shift. Moreover, if the job is a long one, there can easily arise a feeling of non involvement which is hardly conducive to higher productivity.

Even more sensitive is the question of overtime—experience has shown that it is worth estimating the answer to this question carefully for it has an important influence on the results. If a lot of overtime is being worked on the single-shift system and none is proposed for multiple-shifts, management faces the immediate problem of finding a solution which does not involve a reduction in the workers' weekly earnings. There is also the problem of estimating how much average output per man-hour would rise if overtime were eliminated, fatigue reduction being only one consideration. When the decision relates to an existing process some firms try pilot experiments in the hope of getting a reliable indication: often, however, the circumstances are not directly comparable. In one instance, a company that claimed a 50 per cent increase in productivity as a result of a change to double-shifts was able to produce detailed statistical records in support. Output per man-hour had most certainly gone up, but further investigation showed that many important factors had changed—more skilled men had been taken on, the product mix had been changed, several new machines had been installed. Nevertheless, it was probably true that productivity had risen—though not by so much as was claimed—and it was likely that the impact of the reduction in overtime was mainly responsible.

Annual wage bill
This is probably the easiest item of all, and no comment is needed.

Capital-saving
The *capital-saving* is simply the difference in operating hours per year, expressed as a percentage of the total hours worked on the higher utilisation system. It is essential not to forget the productivity adjustments that were outlined in Chapter 4.

In principle, capital* can be valued at original cost, plus, ideally, an allowance for inflation. For a new project purchase cost will be appropriate. This means that the general rate of return should also be based on the original cost. But for a new project, if purchase cost is used, the general rate of return must not be based on written-down values and must reflect the current value of money. It does not matter particularly if the ideal measurements are not available so long as a consistent method is followed both in measuring the capital in a process and in measuring the rate of return. It is important, however, to avoid errors which distort the allocation of total capital between processes—if no allowance is made for inflation, for example, those processes whose equipment will last longer will have their capital under-assessed.

All the fixed capital that is properly attributable to a process should be included; for example, imputed shares of common services, though these can cause problems. Factory space should be valued on a square foot basis: the adjustment for the rise in building costs since the factory was erected may well be considerable, and if no such adjustment is made there could be a misleading understatement of the relative capital intensity of those processes which use a great deal of space. This may account for the common tendency to underestimate the profitability of shiftwork in assembly lines. There will be many points at which a precise estimate or imputation of capital is impossible. Accounts should not be deterred by these difficulties but must make the best estimates they can, trying to be as consistent as possible between cases.

Rate of return
Since the method of assessing capital employed has already been discussed above, we are here concerned only with profits. One starts with the gross profits of the company as a whole, or at least of the factory, assuming a low utilisation system; to these should be added any interest charges which might already have been deducted. Then comes the most difficult calculation of dividing total depreciation of fixed capital between wear and tear and obsolescence. Wear and tear should be seen as those capital costs which tend to vary more or less directly with the *annual use* of equipment rather than mainly because of the passage of time. Accounts will probably have to confer with production staff about this because normal methods of determining depreciation allowances do not usually provide the required kind of information. Production staff should also be asked whether the estimate of wear and tear will vary more or less proportionately to utilisation in case it becomes necessary to take account of the non

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* Fixed capital need not be considered when one is using the whole plant method but will otherwise always be needed. Assessing it may cause some difficulty to accounts—which usually suggests it is time to make some reforms in the accounting system because there are many other reasons why rational business planning requires a fairly detailed knowledge of the capital used in different sections.

neutral behaviour of some neutral costs*. In most cases, the wear and tear estimate need not be very accurate as it usually carries only a small weight in the calculation.

When a figure for wear and tear has been worked out, it should be deducted from gross profits. The resulting figure should be expressed as a percentage of total net assets, *including* inventory costs (whether stocks, work in progress, etc). Next, *this* percentage should be applied to the total inventory to obtain the annual cost of inventory: this should next be deducted from profits. The resulting figure, expressed as a percentage of fixed capital, is the required figure for internal return net of wear and tear.

Neutral costs

These are basically a matter of traditional cost accounting. The essential problem is to work out the forecast costs *per unit of output* on the various optional systems of utilisation—assuming that total sales of the final product are constant at an agreed level. The usual methods for attributing overheads (other than capital) can be employed.

Estimates of inventory costs, especially for a process-by-process calculation, raise issues of principle. In the first place, there is the problem of assessing the value of stocks and work in progress required in the plant for normal annual output (assuming low utilisation). This total must then be assigned to the different processes and no part can be left unassigned. Next the inventory cost element in neutral costs in a given process is obtained by applying the *general rate of return* to the value of the portion of stocks and work in progress attributable to that process. It is then necessary to investigate any cases when shiftwork may possibly make a significant difference one way or the other to annual inventory costs per unit of output. The result should then be incorporated into the general estimate of neutral costs in order to establish whether a cost adjustment, as described in Chapter 4, is needed.

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* See page 18.

Appendix B The effects of multiple-shift working on operating flexibility

In the previous discussion no account has been taken of the effects of breakdowns in equipment or of other factors causing fluctuations in output. There are two different aspects to consider.

First, there is the question whether a shut down of so many days, caused by a breakdown, for example, implies a larger absolute loss of production when using a multiple-shift system than when using single shifts. In general, it is a fallacy to maintain that it does but it could be true in some cases.

Production lost due to delay in obtaining a spare part

uppose a piece of equipment breaks down on Monday morning, and we require rty *eight hours* from the time of telephoning the order for the spare part, to the time is delivered. It will be delivered on Wednesday morning. On a single-shift system shall have lost two shifts of production, on a double-shift system, four. However, ce the output is the same for both systems, the output per shift is only half as great the two-shift system as on the single-shift system, so that the loss of production is the ne. (Profit per unit of output is lower, of course, on the two-shift system, but the *portionate* loss of profit is the same on both, so the effect on the rate of return on capital employed is the same). In this case, therefore, the 'flexibility' argument does not work.

Production lost due to shut-down for repairs

Suppose in the above example the spare part is available in stock. Suppose a *working time* of twelve hours is required to effect the repair, during which time the plant cannot be operated. The plant is ready for work again on Monday evening, having been repaired during the day. One shift has been lost on the single-shift system, and the same on the double-shift system; from the argument of the previous example, this means a *greater* loss on the single-shift system. Alternatively, if the break-down had occurred late on Monday afternoon, provided the repair men can work at night, the argument is reversed. So in this case, depending on the exact circumstances, the effec may go either way.

The belief that shiftwork offers less flexibility in the case of breakdowns arises fron failing to appreciate that, when we are comparing like with like, the loss of productio due to repairs or replacements requiring a given *passage of time* is unlikely to diffe obviously between the two types of systems. This is because, comparing like wit like, we consider the same *annual* output; the output *per twenty four hours* is therefor also the same, but less capital is required on a high utilisation system because given daily output is spread over twenty four hours instead of being concentrate into the daytime period. In other words, this is another example of confusing th effects of a change in the scale of annual output with those of a change in the syster by which it is produced.

Secondly, there is the question of the effects of fluctuations in demand.

Suppose our product is one which is not easily stored in large quantities and w sometimes experience rather sharp *weekly* fluctuations in demand. Consider, fc example, a week in which demand falls to two thirds of normal, and it is imperativ to reduce the week's output by precisely this amount.

On the single-shift system, with a large amount of overtime customarily employed to support normal output, the whole adjustment can be taken on overtime at a considerable saving in cost, which will go some way to mitigating the increased weight of overheads. With the weekly output produced on multiple-shifts without overtime, it will be necessary either (i) to lay off some workers temporarily or (ii) to maintain employment with reduced output or (iii) to put all workers on short time. The first expedient is unlikely to be acceptable, and the third will undoubtedly be unpopular. The second is particularly costly. All methods involve a lesser reduction of the labour bill than in the case where the reduction falls on overtime. Clearly, in this example, the shiftwork system is at a disadvantage. This is a further example of the effect of the system of 'customary' overtime on the shiftwork calculation. The same conclusion would be reached if the repairs in example (ii) above had been carried out during hours normally paid for at overtime rates.

It may also be argued that with low utilisation the firm has a spare margin of capacity which can be used not only by working overtime but also by working shifts in an emergency. This assumes, however, that labour is available, which can be taken on or stood off as required, to man such emergency shifts.

Appendix C Comparison of crude 'rate-of-return' approach with 'discounted cash flow' approach

First principles

The basic problem in investment project appraisal is that the returns to an investment come in over a period of time, and that it is obvious that a return of, say, a thousand pounds expected ten years from now is of less value, now, than the same sum expected only five years hence. But the precise manner in which we should take account of the effects of time in our calculations is not so obvious.

If we have an asset expected to earn a constant amount from the day it is installed and to depreciate at a constant percentage rate per annum, we may set aside the indicated amount of depreciation as a deduction from our profits and express the resulting 'net profits' as a percentage of the value of our *original* investment, and call this the rate of return on the investment. By accumulating a depreciation fund, the value of our total investment is maintained intact, so that what we have done is equivalent to the purchase of a perpetual bond yielding this rate of return. (One way of picturing the situation is to suppose the original investment consisted of a batch of ten machines with a balanced age structure, such that each year one machine disintegrates completely and has to be replaced from the depreciation allowance, while the others remain fully productive until each in turn, disintegrates; by this regular replacement, which costs us ten per cent of the value of the investment each year, we maintain the capital intact.)

The above approach cannot easily be applied if the returns are not expected to arise regularly, eg there may be a long gestation period during which the plant is earning little or nothing. It is then necessary to allow for the effects of time by discounting each individual expected future return back to the present at compound interest. For example, if the assumed discount rate is 10 per cent, a return of £100 expected one year from now is valued at (£100)/1.10, a return of £100 expected two years from now at (£100)/(1.10) (1.10) etc. The present value of the returns is the sum of the discounted individual returns over the whole expected life of the project. The discounted cash flow (DCF) is usually defined as the present value of the returns, less the present value of the various investment outlays, each discounted back to the present from the expected date of actual spending (thus allowing for the fact that the investment itself is not in practice made in a lump at the beginning of the planning period.) If the discounted outlays exceed the discounted returns the project is 'unprofitable', given the assumed discount rate. If the project is profitable, the net discounted profit (or cash flow) can be compared with that on other projects as part of the decision-making process.

The DCF return

The above method requires us to have already determined a discount rate. The higher the chosen discount rate, for any given project, the lower the DCF. (Alternatively, given the discount rate, the DCF will be reduced if the assumed life is reduced). A change in the discount rate will affect two different projects similarly if they have the same life and a similar 'time profile' of returns, but if two projects show the same DCF at a given discount rate, and we then increase the discount rate, a project which happens to offer relatively larger returns in the distant future, and relatively smaller returns in the near future (as compared with the other), will be more adversely affected by the increase. The higher the discount rate we choose, the greater the relative value we are placing on quick returns.

An alternative method, based on exactly the same underlying principles, *defines* the return on a project as *that rate of discount which, if applied to the expected outlays and returns* (in the way described above) *will just make the DCF zero*, ie make the discounted future returns just equal to the discounted outlays. In the case of a project with no gestation period, where the entire investment outlay is disbursed in one lump at the beginning of the period, this method is measured by Keynes' 'marginal efficiency of capital', which he defined as the rate of discount which would make the discounted returns just equal to the cost of the asset (which in this case is an 'outlay' to which no discount factor applies, because it occurs right at the beginning of the period). This concept can also be referred to as the DCF return. Notice that it is not necessary to make any specific allowance for obsolescence depreciation; this is built in to the calculation when estimating the life of the project.

The most convenient way to apply the DCF method to the shiftwork problem is to find out which method of working (low utilisation or high utilisation) yields the best DCF return.

DCF return in a shiftwork calculation

It follows from the preceding arguments that the DCF approach will give exactly the same answers as the rate of return approach, unless the change to a system of higher utilisation affects the time profile of returns. But there is no obvious reason why the time profile should be affected. For example, in the data analysed in Table 1 (see page 9), none of the cases have a gestation period. Case A yields annual gross profits of £300* a year on an unspecified life (£250 net of wear and tear, plus £50 wear and tear depreciation). If a constant percentage rate of depreciation is literally applied, the value of the asset never actually reaches zero, although it is, of course, converging to zero in the infinite. But the theoretical 'life' of the asset is given by the reciprocal of the depreciation rate, in this case, 1200/(50 + 120), = 7 years . . . the first figure being the initial investment, the second wear and tear depreciation and the third obsolescence depreciation, which for lack of any more specific information are assumed constant over the whole period.

Case D yields £175 gross profits annually against a much smaller investment, representing the same rate of return. But again in the absence of special information we assume that these profits flow at an even annual rate, so we should expect the DCF return also to be the same. † Let us check if this is so.

DCF return for the example in Table 1

To compare cases A and D in Table 1, let us treat the wear and tear depreciation as a current maintenance charge; in other words, assume that provided this amount is spent on maintenance each year, the equipment will retain its value were it not for obsolescence. Then let us assume that owing to obsolescence the life of the project is in fact seven years, (at the end of which the equipment is valueless either due to decay in the market for the product, or to the appearance of better equipment or both). This obsolescence life is, of course, the *same* whether we employ high utilisation or low, ie is assumed the same in both cases.

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* The figures in Table 1 were in terms of £000's. For the sake of simplicity the 000's have been omitted in this and the following paragraphs.

† The most important cases where this is not true (and DCF is required) are those where wear and tear per unit of output begins to increase rapidly after the equipment has run for a certain number of hours and may eventually cease to be worth repairing.

Given the proposed treatment of wear and tear, the annual returns in each case are the profits net of wear and tear. In case A, therefore, we have to add up the series £250/(1 + r) + £250/$(1 + r)^2$ . . . + £250 $(1 + r)^7$ and in case D, the same series with the figure £125 substituted for the figure £250, with the letter 'r' standing for the rate of discount. To find the DCF return we must find a value for 'r' which just sets the sum of the series equal to £1,200 (the initial outlay) in case A and to £600 in case D. The right figure turns out to be 11% in *both cases*. In other words, not only is the return the same on both systems, as in Table 1, *but it is the same return*. This is because the assumed life was in fact chosen to be the same as the theoretical life implied in the depreciation rates assumed in the table. Using this life, all the results are exactly the same as using the rate of return approach; the rate of return we previously calculated is, in fact, the DCF return.

What happens if we alter the assumed life? This is equivalent to altering the assumed rate of obsolescence. Now it was quite clear in the earlier discussion that since the rate of obsolescence was *unaffected* by the shift work decision, although it could alter the *level* of profitability in the various examples, it should not alter the *relative* profitability. If cases A and D represented a critical example (same result for low utilisation as for high) using one rate of obsolescence, they should continue to do so when using any other rate. Consequently, we should expect a change in the length of life due to changed obsolescence conditions to leave the relation between the DCF returns also unchanged; in other words, they must both move by the same amount. This turns out to be the case. For example, with a six year life the DCF return becomes 7 per cent, both in case A and in case D.

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National Economic Development Office

Multiple Shiftwork

a problem for decision by management and labour

based on a paper
prepared by
R L Marris, Sc D,
Director of Studies
in Economics,
King's College, Cambridge

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Foreword

Greater efficiency and faster growth require improved use of manpower and capital. It is wasteful to use capital equipment for only a small fraction of the time, especially when the end of its useful life is likely to be determined by obsolescence rather than physical wear and tear. Shiftworking can make an important contribution to improved use of capital but an assessment of the economic benefits for individual companies is not straightforward. The Labour Utilisation Committee of the National Economic Development Council felt that there was an obvious need to stimulate debate on the problems of assessing the economic advantages of shiftworking. They therefore commissioned Dr Robin Marris, the author of a major work on the subject*, to prepare a brief paper for wider dissemination in industry.

This booklet is based on Dr Marris's work. Members of the Labour Utilisation Committee and others have commented on the drafts but the views expressed remain those of Dr Marris. The National Economic Development Office hope that it will be of value to those concerned with reaching decisions about shiftworking, including accountants, production and personnel managers, as well as trade union officials. Equally it is hoped that it will lead to further study and discussion of a complex subject.

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* *The economics of capital utilisation. A report on multiple-shift work.* R. Marris, assisted by I Maclean and S Bernau. Cambridge University Press 1964.

Introduction

Shiftworking would appear to bring clear economic benefits from the national point of view. It leads to a saving in capital, making it possible to obtain a higher volume of output from a given stock of capital. The increased productivity of capital which results should lead to a faster rate of economic growth. The more intensive utilisation of capital is likely to lead to a quicker writing-off and hence renewal of capital and therefore to a faster rate of technical progress.

From the point of view of international competition it is desirable that UK industries should be renewing their capital at least as fast as those of competing countries. If other countries are able to utilise their capital more intensively through having higher degrees of shiftworking their rates of technical progress, and the growth of their living standards, are likely to be faster than ours.

For the individual firm the chief advantage of shiftworking is that it should make it possible for the firm to obtain a higher rate of return on its capital than with single shifts. At first sight, therefore, it would appear that more shiftworking is economically desirable, and that British industry should adopt it more widely. But a premium above the rates of pay for the normal working day nearly always has to be paid to employees for working shifts. The financial advantage to management of working shifts, through the saving in capital costs, is thus reduced by higher labour costs and, depending on the extent of the premium, could even be nullified. The problem for management therefore is how to decide where the balance of advantage lies. There are many factors to take into account, and it is difficult for management to arrive at the right decision.

The booklet is concerned with the economic issues but there are, of course, other considerations involved in the shiftworking decision. There are other practical issues for management arising from such questions as the availability of labour and problems of arranging for supervision and maintenance. There are also important social considerations—in the first place, the extent to which people want, as individual workers or as a community, to work outside what is regarded as the normal working day, whether in evenings or night shifts or at weekends; what the pattern of shifts should be; and the provision of facilities (for example, transport) for shift workers. There are industrial relations issues—the involvement of workers, as well as management, in the decision about shift premia. There are considerations of the effect of shiftwork on health, such as are now being investigated by the TUC Centenary Institute of Occupational Health. It would not have been appropriate to go into all of these issues in this booklet. Some of the practical problems associated with the introduction of shiftworking were dealt with in a report published by the DEP (then the Ministry of Labour) in 1967: *The introduction of shiftworking: a survey*.

One important question to which Dr Marris draws attention is the connection between the shiftworking decision and the amount of overtime being worked in a particular plant or on a particular process; his view is that in the UK we seem to have gone in for too much overtime, too low productivity and too little shiftwork. While this booklet was in preparation the Secretary of State for Employment and Productivity referred to the National Board for Prices and Incomes for investigation the relationship between the length and pattern of the working week, including hours of overtime and shiftwork, and earnings, costs and productivity.*

Appendices B and C of the booklet, considering respectively how multiple-shiftworking affects operating flexibility and how the discounted cash flow approach applies to the calculations about shiftwork, have been included as a result of discussions which Dr Marris has had at seminars organised by the British Institute of Management and of comments by individual business men and groups

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* The Board's report on this reference was due to be published towards the end of 1970.

Summary of the argument

Multiple-shift working is a way of achieving greater use of industrial capital. It usually involves higher labour costs per unit of output. When considering a move to shiftwork an employer has to set the higher potential profits due to capital saving against the reduction in profits that is likely because of higher labour costs.

There are two main methods by which the balance of advantage to the employer can be calculated. One approach shows which shift system will give the highest return on capital employed; the other shows which will yield the lowest cost of production per unit of output. The two methods do not always give the same answer, and the first approach is to be preferred because it is more generally valid.

The booklet examines a typical case of a company which, in order to meet an increase in demand, has to decide whether to adopt a double-shift system or increase overtime on its single-shift system. (One of the most important factors in a shiftwork decision is the expected scale of output because below a certain level industrial equipment cannot be sub-divided). Assuming, however, that the scale of output is not a restraint, the key factors to consider are the differential in wages between single and multiple shifts, which is paid in order to get greater utilisation of machinery; the reduction in capital required that results from greater utilisation; and the ratio of profits (net of wear and tear) to the wages bill.

It sets out a fomula for making the calculation for which it should not be too difficult to find the figures. A system of working involving greater utilisation of equipment (ie a higher degree of shiftworking) is economic if the price that has to be paid in terms of higher wages to get a saving in the capital required (expressed as the ratio of the percentage increase in wages to the percentage saving in capital) is low relative to the ratio of profits to the wages bill. The formula has to be adjusted to take account of differences in productivity that result from the move from single to multiple-shift working, of significant changes in those costs which do not normally change per unit of output as a result of shiftworking, and of the fact that some processes in a factory can be more efficiently operated on shiftwork than others.

For management, then, shiftworking can be a way of raising the rate of return on capital employed. For employees it should mean higher *hourly* earnings although as, where it involves the elimination of overtime, it may mean a reduction in average hours worked, the effect on their *weekly* earnings is less predictable. Employees should, however, share in the benefits of higher productivity which shiftworking may lead to. From the national point of view it should assist the faster growth of the economy.